GEOLOGICAL SURVEY CIRCULAR 311

# A FLUORIMETER FOR SOLUTIONS

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UNITED STATES DEPARTMENT OF THE INTERIOR
Douglas McKay, Secretary

GEOLOGICAL SURVEY
W. E. Wrather, Director

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By Mary H. Fletcher and E. Ray Warner

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Free on application to the Geological Survey, Washington 25, D. C.

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ILLUSTRATIONS




## ABSTRACT

A description of and complete drawings for the construction of a fluorimeter for the measurement of fluorescence of solutions are given. The instrument is sturdy and versatile. It may be used with various phototubes and measuring devices. It is constructed so that phototubes and filters may be changed readily. Sensitivity is controlled easily over a wide range by limiting the size of either the ultraviolet or fluorescent light beam with standard apertures.


## DESCRIPTION OF THE INSTRUMENT

Several years ago it became apparent in the Trace Elements laboratory of the Geological Survey that fluorimetric methods of analysis would greatly expedite the determination of aluminum and beryllium, and would probably be of great help in other determinations as well. The fluorimetric attachment for the Beckman spectrophotometer,[1] designed at the U. S. Bureau of Mines, could have been used for the measurements required in these analyses. However, it was desirable to have a completely self-contained instrument with which any of various suitable phototubes and measuring devices could be used. Such an instrument would give greater flexibility, and allow for the substitution of measuring units much less expensive than the Beckman instrument.

By the addition of a shutter and a suitable coupling device for attaching the phototube housing, the Bureau of Mines' fluorimetric attachment could be converted to a self-contained instrument. Therefore, these changes were incorporated into the fluorimeter described here. The coupling screw was threaded to fit the search unit of the Photovolt electronic photometer (model 512); when other phototubes are used they are provided with housings having the same thread as the Photovolt search units.

[1] Fletcher, Mary H., White, Charles E., and Sheftel, Milton S., 1946, Fluorometric attachment for the Beckman spectrophotometer; Ind. and Eng. Chemistry, Anal. Ed. 18, p. 204.

The new instrument is, in general, very much like the Bureau of Mines instrument.[2] The shape and size of the lamp housings and cell compartments of both instruments are almost identical, although the ventilating louvers in the lamp housing of the new instrument are of a simpler design. Features of the new fluorimeter that do not appear in the Bureau of Mines instrument are two built-in rotary selector discs, that have various-sized apertures, which are between the sample cell and the phototube. This arrangement gives an easy and immediate sensitivity control by regulating the amount of fluorescent light reaching the phototube. Additional control of the sensitivity may be obtained by the use of standard diaphragms that are placed in the filter holders in the path of either the ultraviolet or fluorescent light. A set of these diaphragms with graduated apertures is provided with the instrument.

The accessory parts of the new fluorimeter are the same as those used in the earlier one. A General Electric BH-4 lamp is used as the excitation source. The lamp is operated from a Sola constant wattage transformer no. 301883, designed for the operation of H-4 lamps, and its temperature is controlled by ventilation with a Bon-Air darkroom ventilator. The filter holders accommodate 2- by 2-inch filters that may be readily interchanged as desired.

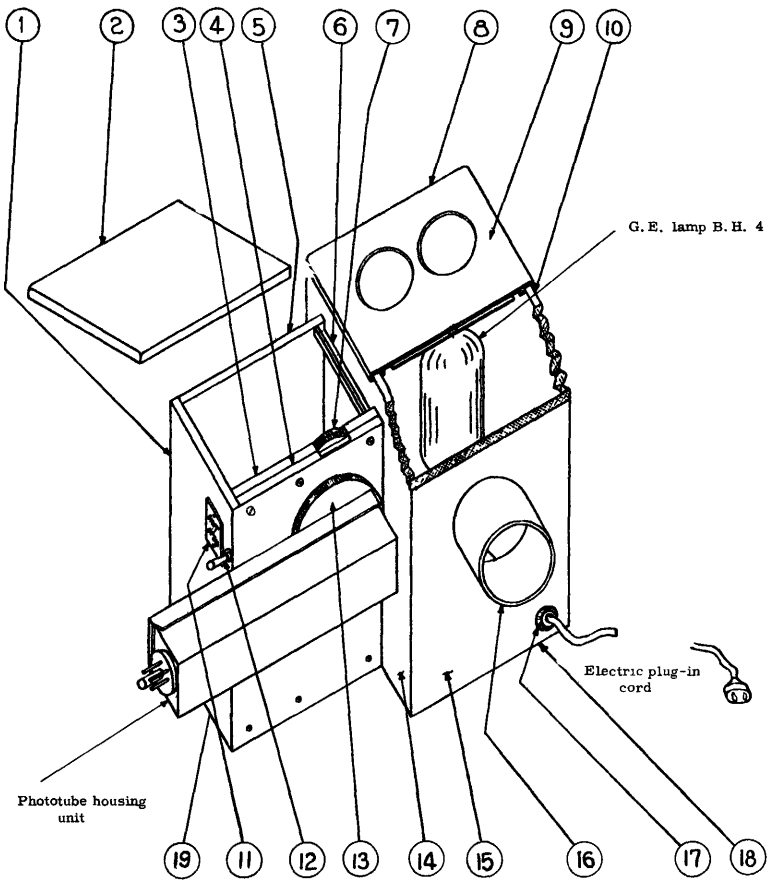
At present we are using a Photovolt electronic photometer (model 512) as the measuring unit, and find that its sensitivity is equal to or slightly better than that obtained when a Bechman spectrophotometer is used as the measuring unit.

Complete drawings for the construction of this fluorimeter appear in figures 1 to 8.


## ACKNOWLEDGMENT

We are indebted to John V. Waitowitz, U. S. Geological Survey, who prepared the shop drawings for the construction of the instrument.

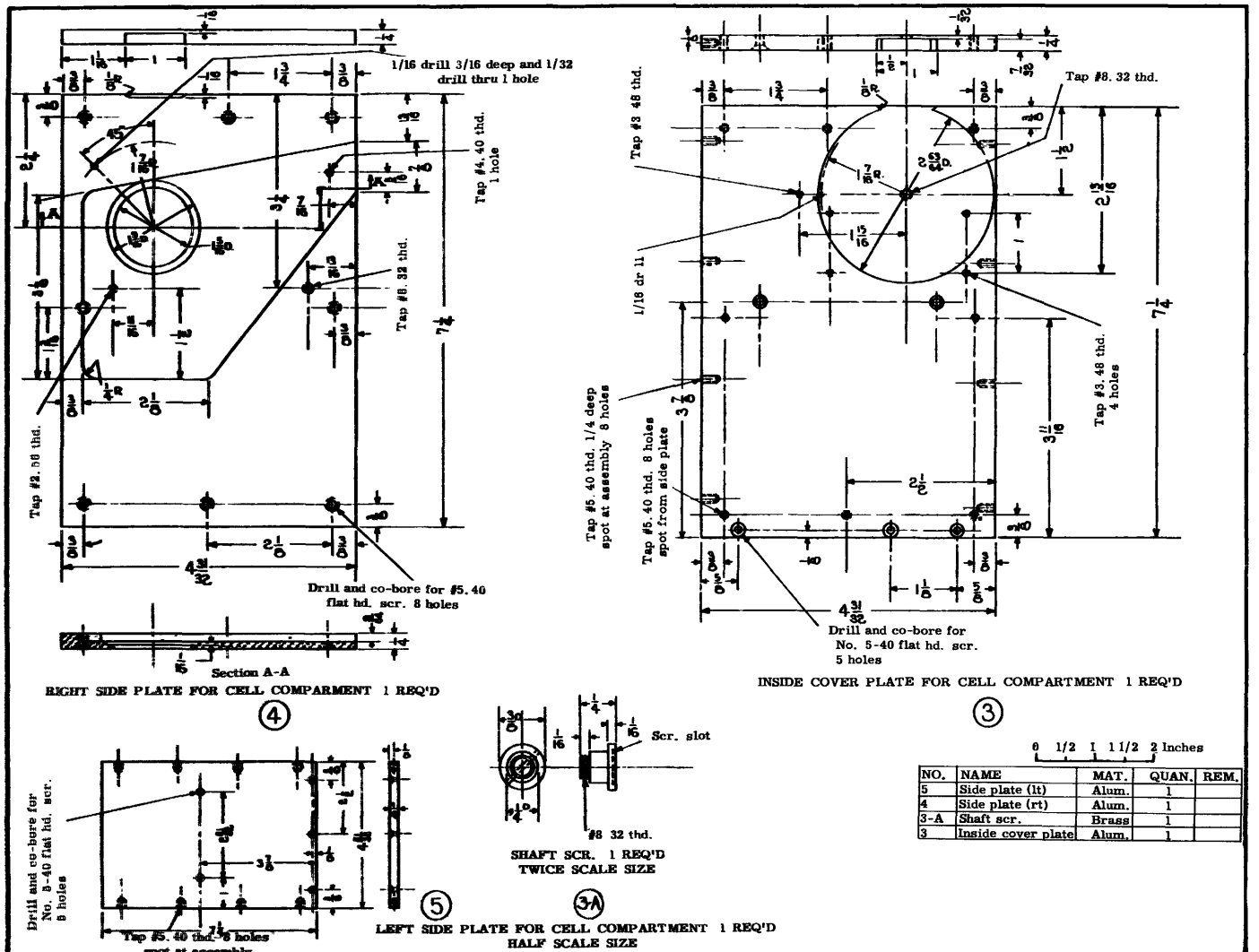

[2] Fletcher and others, 1946, op. cit.




0 1 2 3 4 Inches

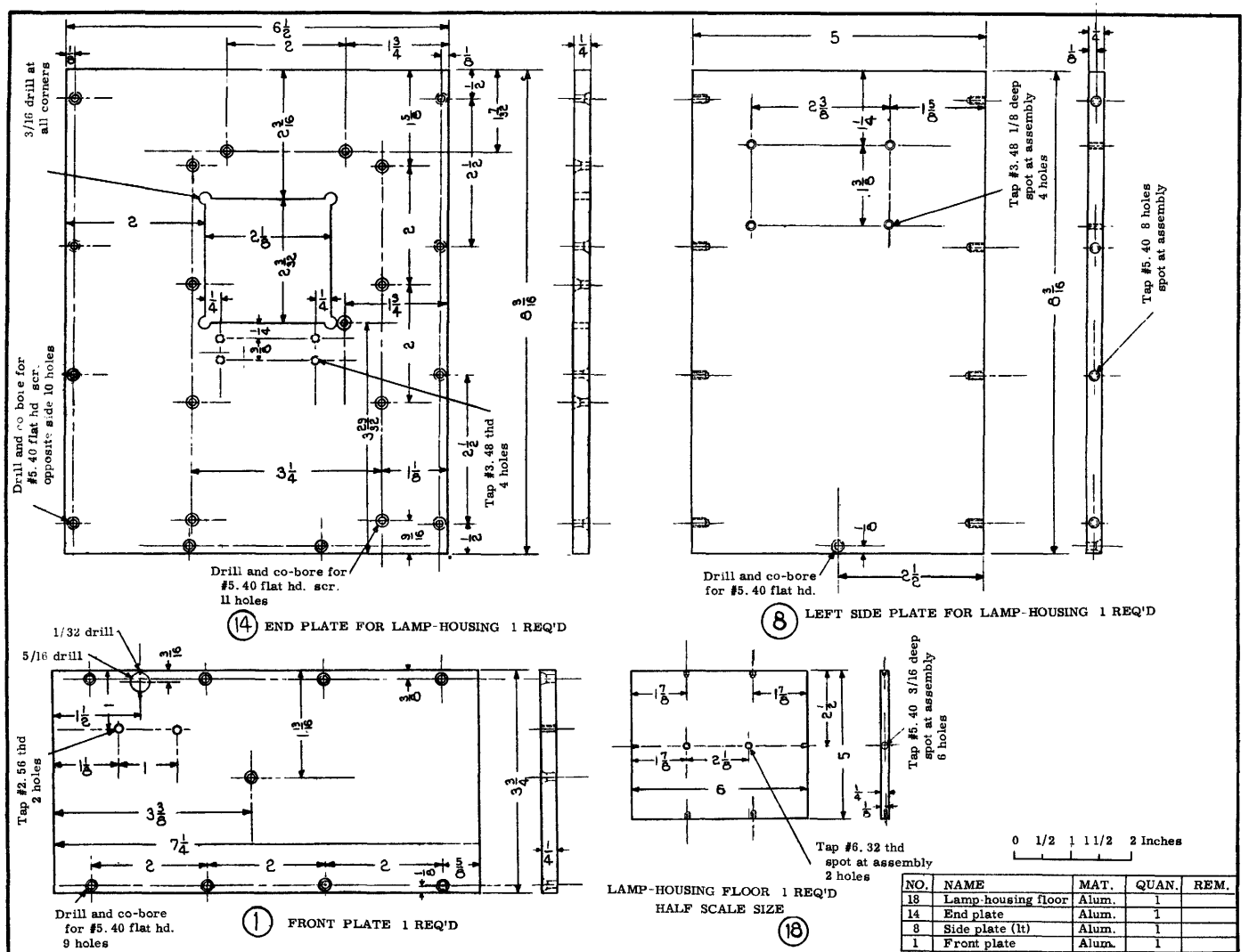
| NO. | NAME | MAT. | QUAN. | REM. |
|---|---|---|---|---|
| | Button hd. scr. | Brass | 1 | #1-80 X 1/8 |
| | Button hd. scr. | Brass | 5 | #3-48 X 1/4 |
| | Hdlss. set scr. | Brass | 1 | #2-56 X 1/8 |
| | Fil. hd. scr. | Brass | 2 | #3-48 X 3/8 |
| | Button hd. scr. | Brass | 13 | #3-48 X 3/16 |
| | Button hd. scr. | Brass | 3 | #2-56 X 3/16 |
| | Flat hd. scr. | Brass | 45 | #5-40 X 3/8 |
| 18 | Lamp-housing floor | | | Fig. #4 |
| 17 | Cord flange | Plastic | 1 | Std. |
| 16 | Vent for fan | | | Fig. #8 |
| 15 | Lamp-housing side plate | | | Fig. #7 |
| 14 | End plate | | | Fig. #4 |
| 13 | Unit attach flange | | | Fig. #6 |
| 12 | Shutter toggle | | | Fig. #5 |
| 11 | Direction plate | | | Fig. #7 |
| 10 | Back plate | | | Fig. #7 |
| 9 | Air-vent cover | | | Fig. #8 |
| 8 | Lamp-housing side plate | | | Fig. #4 |
| 7 | Dial selector | | | Fig. #5 |
| 6 | Rib | | | Fig. #6 |
| 5 | Side plate (lt) | | | Fig. #3 |
| 4 | Side plate (rt) | | | Fig. #3 |
| 3 | Inside cover plate | | | Fig. #3 |
| 2 | Cell comp. cover | | | Fig. #8 |
| 1 | Front plate | | | Fig. #4 |
| 19 | Cell compartment floor | | | Fig. #7 |

Figure 1. Fluorimeter for solutions—cover removed.



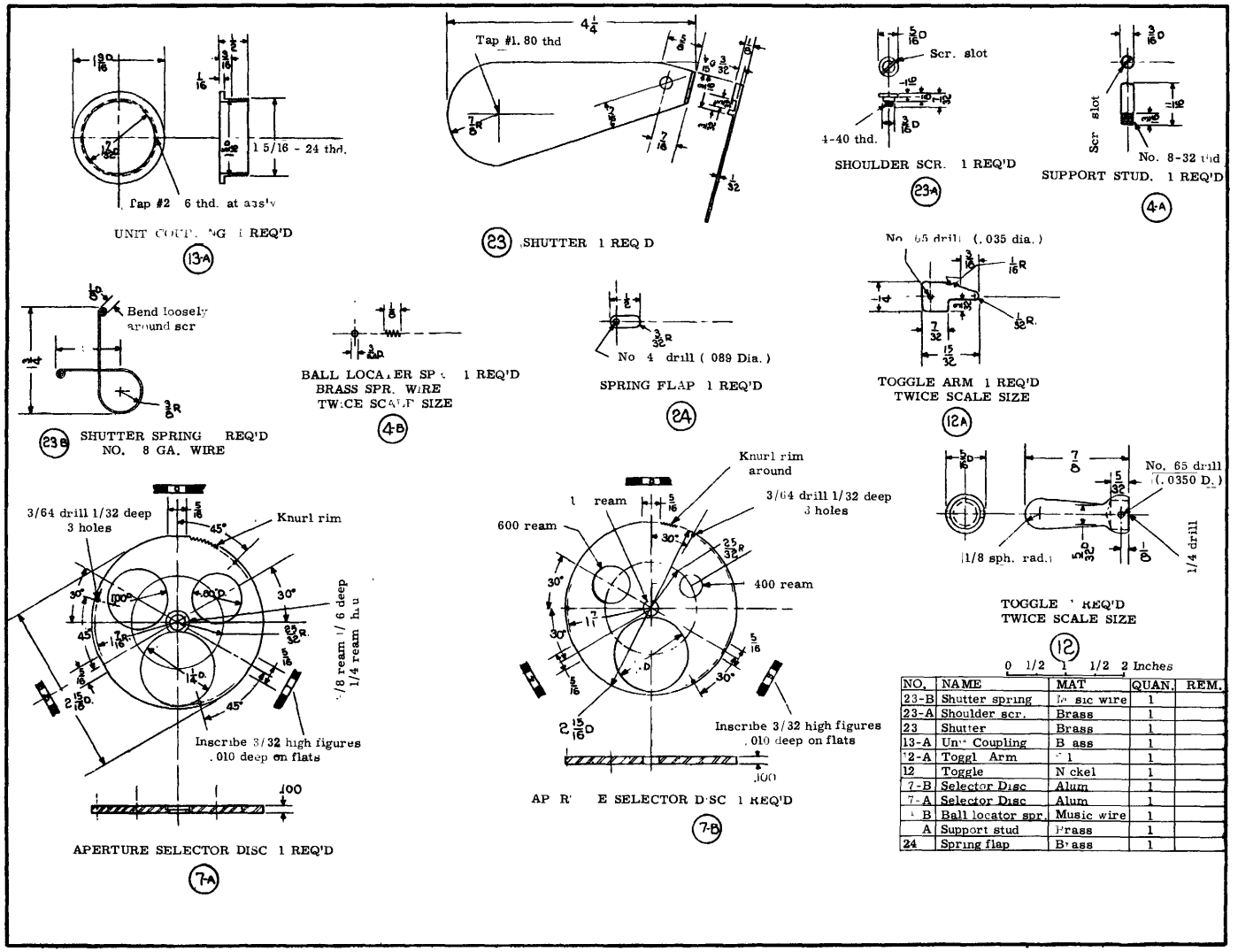

| NO. | NAME | MAT. | QUAN. | REM. |
|---|---|---|---|---|
| 5 | Side plate (lt) | Alum. | 1 | |
| 4 | Side plate (rt) | Alum. | 1 | |
| 3-A | Shaft scr. | Brass | 1 | |
| 3 | Inside cover plate | Alum. | 1 | |

**Figure 3. Details of cell compartment parts shown in figure 1.**



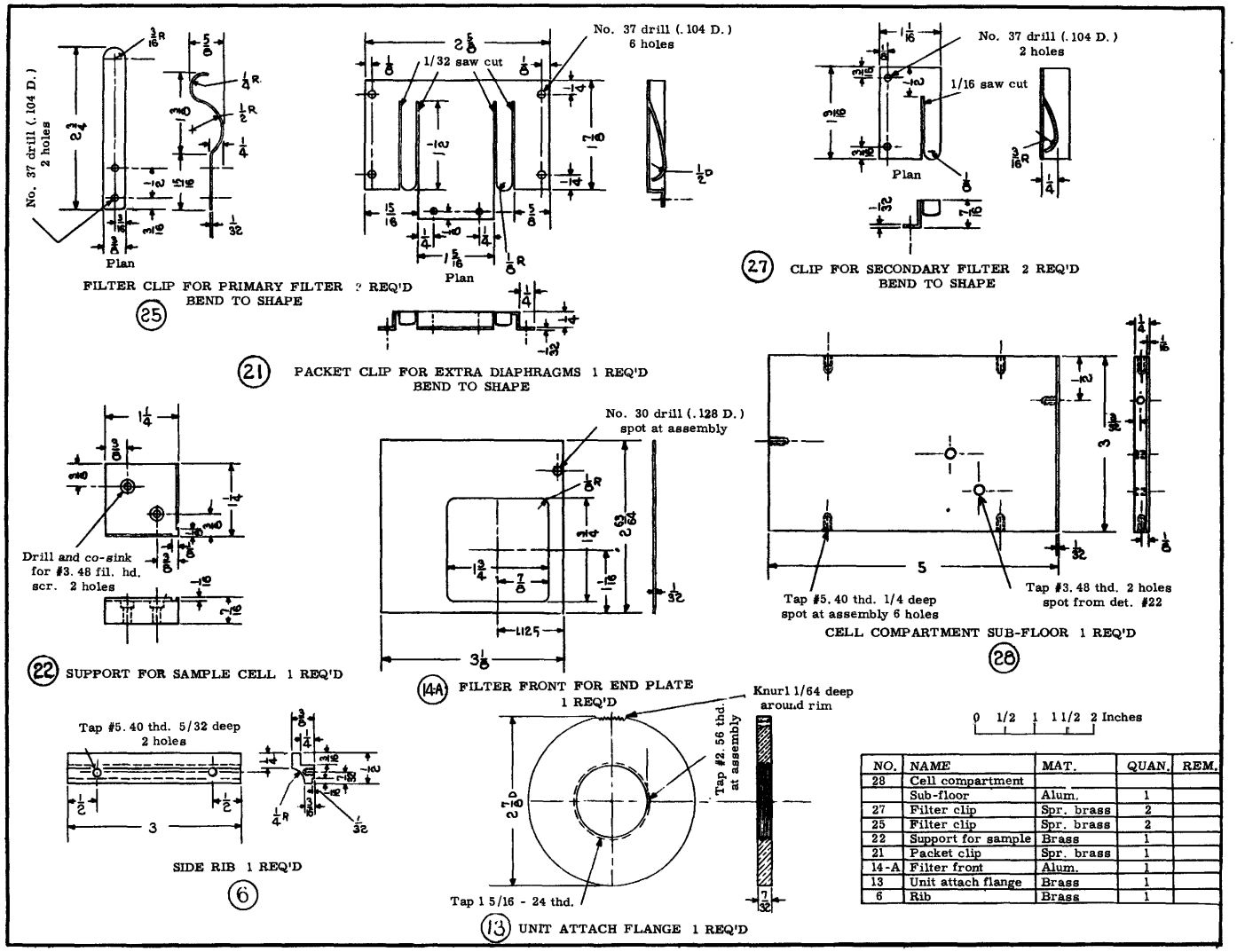

| NO. | NAME | MAT. | QUAN. | REM. |
|---|---|---|---|---|
| 18 | Lamp-housing floor | Alum. | 1 | |
| 14 | End plate | Alum. | 1 | |
| 8 | Side plate (lt) | Alum. | 1 | |
| 1 | Front plate | Alum. | 1 | |

Figure 4. Details of parts shown in figure 1.



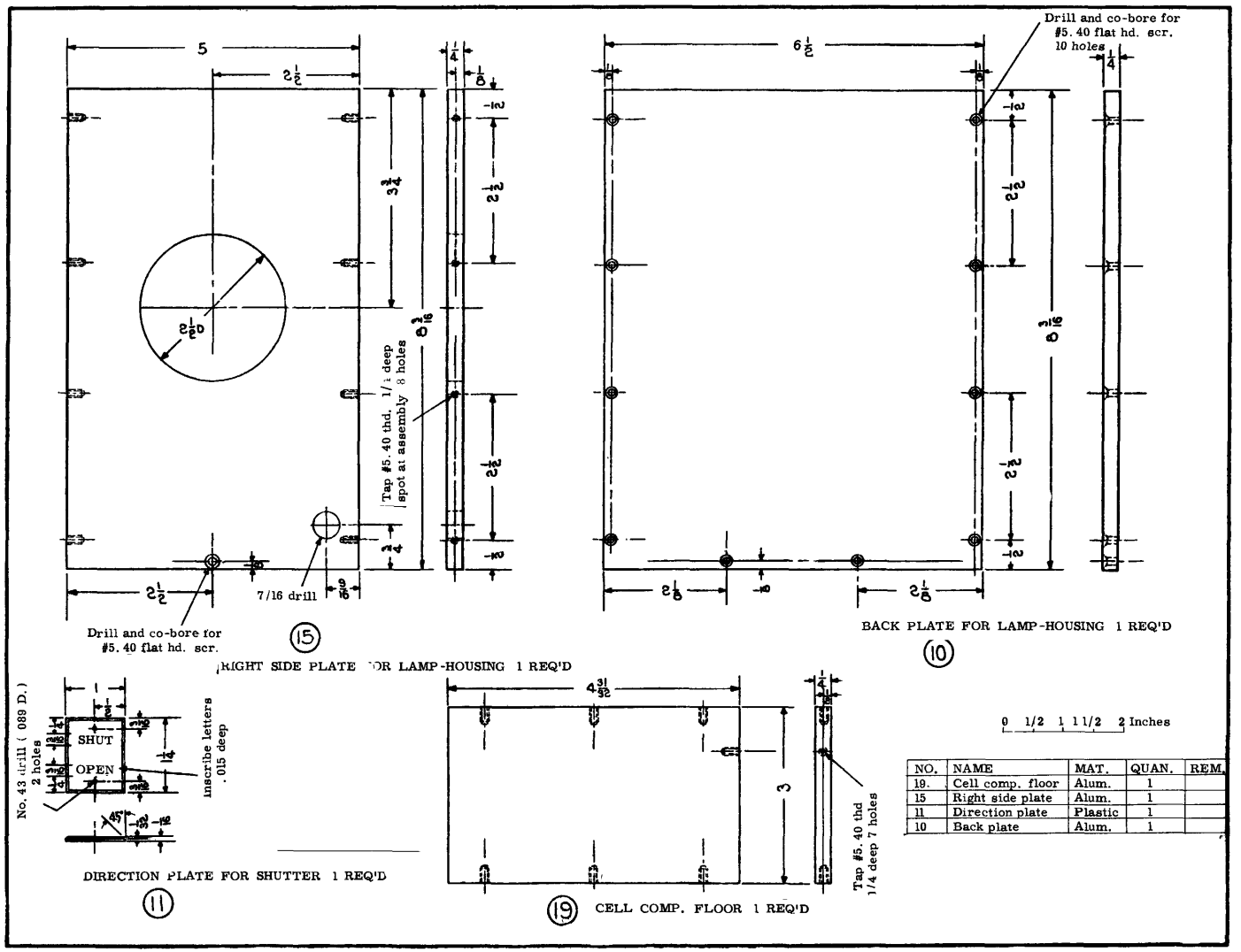

| NO. | NAME | MAT | QUAN. | REM. |
|---|---|---|---|---|
| 23-B | Shutter spring | Music wire | 1 | |
| 23-A | Shoulder scr. | Brass | 1 | |
| 23 | Shutter | Brass | 1 | |
| 13-A | Unit Coupling | Brass | 1 | |
| 12-A | Toggl Arm | Steel | 1 | |
| 12 | Toggle | Nickel | 1 | |
| 7-B | Selector Disc | Alum | 1 | |
| 7-A | Selector Disc | Alum | 1 | |
| 4-B | Ball locator spr. | Music wire | 1 | |
| 4-A | Support stud | Brass | 1 | |
| 24 | Spring flap | Brass | 1 | |

Figure 5. Details of parts shown in figures 1 and 2.



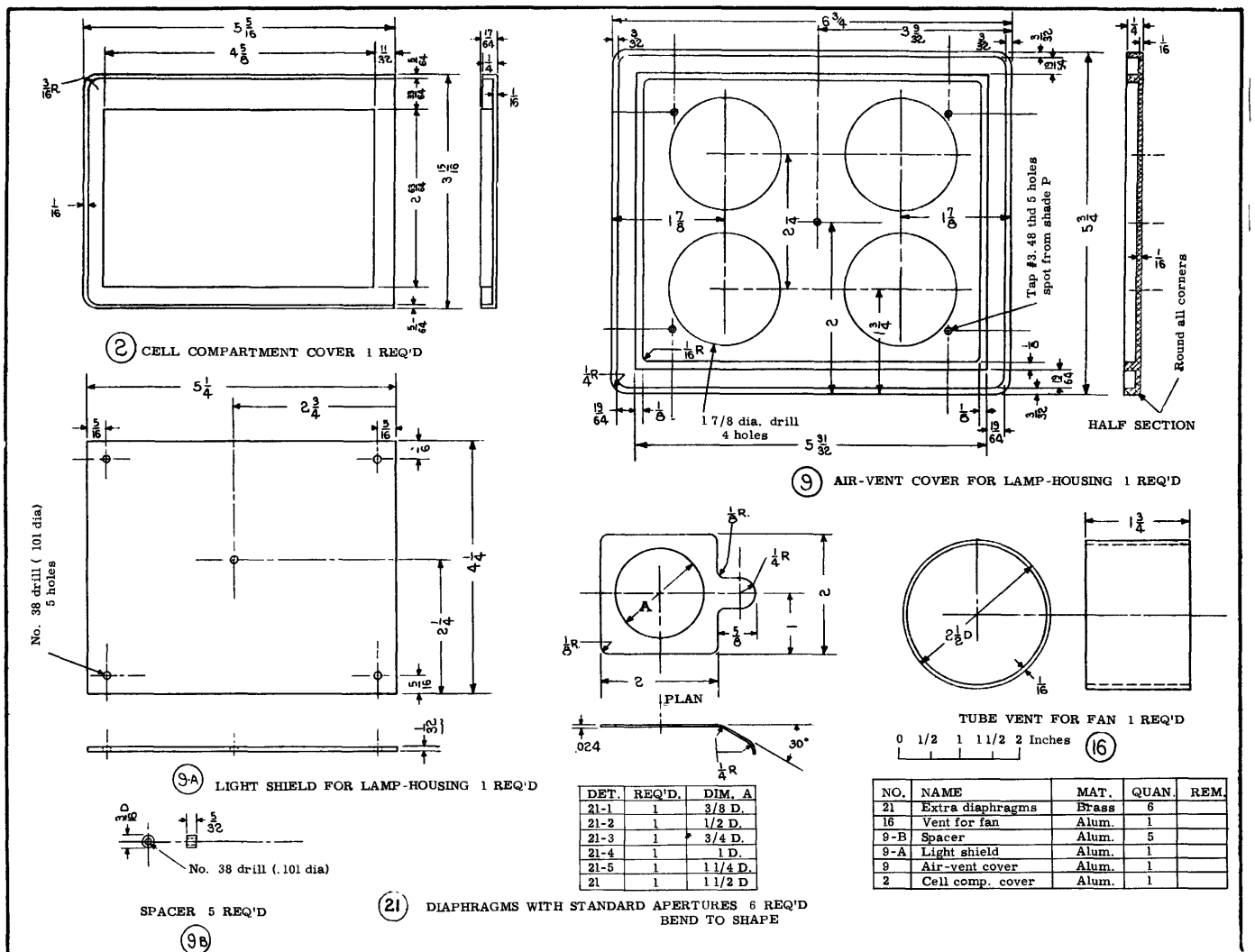

| NO. | NAME | MAT. | QUAN. | REM. |
|---|---|---|---|---|
| 28 | Cell compartment | | | |
| | Sub-floor | Alum. | 1 | |
| 27 | Filter clip | Spr. brass | 2 | |
| 25 | Filter clip | Spr. brass | 2 | |
| 22 | Support for sample | Brass | 1 | |
| 21 | Packet clip | Spr. brass | 1 | |
| 14-A | Filter front | Alum. | 1 | |
| 13 | Unit attach flange | Brass | 1 | |
| 6 | Rib | Brass | 1 | |

Figure 6. Details of parts shown in figures 1 and 2.




| NO. | NAME | MAT. | QUAN. | REM. |
|---|---|---|---|---|
| 19. | Cell comp. floor | Alum. | 1 | |
| 15 | Right side plate | Alum. | 1 | |
| 11 | Direction plate | Plastic | 1 | |
| 10 | Back plate | Alum. | 1 | |

Figure 7. Details of parts shown in figure 1.




| DET. | REQ'D. | DIM. A |
|---|---|---|
| 21-1 | 1 | 3/8 D. |
| 21-2 | 1 | 1/2 D. |
| 21-3 | 1 | 3/4 D. |
| 21-4 | 1 | 1 D. |
| 21-5 | 1 | 1 1/4 D. |
| 21 | 1 | 1 1/2 D |

| NO. | NAME | MAT. | QUAN. | REM. |
|---|---|---|---|---|
| 21 | Extra diaphragms | Brass | 6 | |
| 16 | Vent for fan | Alum. | 1 | |
| 9-B | Spacer | Alum. | 5 | |
| 9-A | Light shield | Alum. | 1 | |
| 9 | Air-vent cover | Alum. | 1 | |
| 2 | Cell comp. cover | Alum. | 1 | |

**Figure 8. Details of parts shown in figure 1.**